Software Quality & Safety Assessment Using Bayesian Belief Networks

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Problems Under Consideration

- GETR: How does one decide that a software system is “good enough to release”?
- SWQ-BBN: Can I combine process assessment and product assessment metrics to predict quality/reliability of a software system?

Approach: Bayesian Belief Networks (BBN)

- We use BBN models as the basis of both projects
- BBN models effectively allow the combination of quantitative and qualitative assessment (that is, measures and expert judgment) in the same model

GETR Approach

- For the GETR (Good Enough to Release) project, we are developing a BBN model of the decision process
  - What evidence is used, and how is it weighed
  - Determining conditional probabilities from expert opinion (to get probability parameters for the model)
- GETR is building a mathematical framework based on BBN to understand and facilitate the decision making process

SWQ BBN Approach

- For the SWQ BBN project, we are developing techniques to build a BN to model the software development process and the products (artifacts)
  - BBN model represents causally related phases and activities within the phases.
  - Measurements or expert opinion can be used to determine probability parameters for the model.

- Model can be used to assess the process/product with respect to reliability (defect density) or other quality attribute

Benefits of the BBN approach

- Modeling the GETR decision documents and formalizes the decision process, allowing for documentation, analysis and policy decisions
- Modeling the SW development process allows the evaluation of both process and product information for a particular project.
- Using the framework we're developing may allow comparisons of different processes for development or decision making.

Relevance to NASA

- Project managers with “lightweight” V&V requirements will use the GETR results to help manage the V&V activities.
- GETR was used to help develop a “Seal of Approval Process” for PRA tools within NASA.
- The SWQ-BBN model can be used to produce an estimate of the reliability or defect count of SW. Such an estimate can then be used to support PRA.

Accomplishments

- GETR: BBN model has been developed and populated via literature survey and expert elicitation. Preliminary mathematical derivation of methodology including proof of coherence and importance analysis. Identification of several potential case studies.
- SWQ-BBN: Preliminary BBN model developed for SW development process activities, identification of metrics for populating model, preliminary derivation of analysis approach, identification of specific application domain (OO systems) and case study.

Next Steps

- Mathematical derivation of modeling framework
- Case studies using data from NASA projects
- Identification of NASA projects for feasibility demonstration
  - Consideration of internal (cross-center) release of analysis tool.
  - SW project is working with Titan to develop process and model for IV&V of OO systems.